The Strategic Role of Exchange Programs

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Exchange Programs: Consumers turn in an old item in return for store credit, a gift card, or a discount for purchase of a new product.

Many different categories are included in such exchange programs.
Big Bazaar Super Market in India

Old goods (e.g., pots and pans, furniture, plastic ware, newspapers) are weighed/valued and the customers are given exchange coupons.
Introduction

Consumer Electronics Chain Store Gome in China

Cross-category consumer electronics and home appliances trade-in for exchange coupons

Desai, Purohit and Zhou (Duke University)
Costco and its Exchange Program Partner Gazelle
Exchange Program by Costco and Gazelle

Answer these questions to get your offer:

1. MAKES A CALL SUCCESSFULLY? 🔜
   - YES 🔵
   - NO ✗

2. FREE OF WATER DAMAGE? 🔜
   - YES 🔵
   - NO ✗

3. RATE THE OVERALL CONDITION 🔜
   - POOR ✗
   - FAIR 🔵
   - GOOD 🔵
   - PERFECT 🔵

4. I HAVE:
   - AC ADAPTER 🔵
   - ORIGINAL CABLES 🔵

WE’LL PAY YOU

$169

Offer Protected

Add to Box

Why sell now?

OUR PROMISE
- Every item gets an offer
- Free shipping and packaging for qualifying items
- Personal data wiped from all items

YOUR DATA IS SAFE
We wipe all items clean of personal data as part of our standard inspection process.
Trade-in/Buyback Programs

Gaining popularity in the U.S.:
- Verizon Wireless
- Best Buy
- Radio Shack
- Home Depot
- Staples
Literature Review


Research Questions

- Why exchange programs?
- When to offer exchange programs in a competitive context?
- What are the optimal pricing strategies and exchange coupon amount?
- What are the effects of loss aversion on exchange programs (equilibrium outcome, price and exchange discount)?
Model Setup: Firms

- Two symmetric firms ($i = A, B$), located at opposite ends of a Hotelling line
- First decide whether or not to offer exchange programs
- If Firm $i$ offers an exchange program:
  - Retail price for the new good, $P_i$
  - Exchange compensation $e_i$ (if consumers bring in their used goods)
  - All exchange consumers get the same $e_i$ (e.g., CA Cash for Appliances)
  - Zero disposal cost or benefit of old goods
- Without exchange program:
  - Firms only set retail prices for the new goods: $P_i$
Model Setup: Consumers

- Consumers differ in terms of their valuation for the new good, their preferences for the two firms, their ownership of old goods, and their valuation for the old goods (if they own any).
- Valuation for old goods represented as mental book value of the old goods.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Valuation for New</th>
<th>Size</th>
<th>Mental Book Value of Old</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>$\theta_H$</td>
<td>$1 - \lambda$</td>
<td>$M_H$</td>
</tr>
<tr>
<td>L</td>
<td>$\theta_L$</td>
<td>$\lambda$</td>
<td>$M_L$</td>
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- Assume $\theta_H > \theta_L$ WLOG
- Main case: $M_H > M_L$; $M_H < M_L$ also analyzed
Model Setup: Consumer Segments

- Preferences for two firms represented by each consumer’s location on the line segment and transportation cost $t$.
- A fraction $f$ of consumers have old goods qualified for exchange and they incur a storage cost $K$ if they keep the old good:
  1. H with old: HO, size = $(1 - \lambda)f$
  2. H without old: HN, size = $(1 - \lambda)(1 - f)$
  3. L with old: LO, size = $\lambda f$
  4. L with old: LN, size = $\lambda (1 - f)$

- Purchase at most one new good.
Consumer Options of Old and New Goods

Model

Old

Keep old

Private sale

Exchange

New

Buy new

Do not buy new
Consumer Options and Utility Specification

We need to account for consumer utilities from old and new goods

1. Buy new, keep old:
   \[ u = \theta_m - P_i - t x + M_m - K, \quad m = H, L, \quad i = A, B \]

2. Buy new and exchange:
   \[ u = \theta_m - P_i - t x + e_i - Z, \text{ where } Z = M_m + a, \quad a: \text{ loss aversion}. \]

3. Do not buy new and keep old:
   \[ u = M_m - K \]

4. Buy new, private sale of old:
   \[ u = \theta_m - P_i - t x + P_0 - Z \]

5. Do not buy new and engage in private sale of the old:
   \[ u = P_0 - Z \]
Assume $P_0$ is so small that it is never optimal to do private sale.
- Costly private sale
- Exchange programs

Assume large $\theta_H$ and moderate $\theta_L$ so that
- Full coverage in HO and HN segments
- Partial coverage in LO and LN

Assume large $M_H$ and moderate $M_L$:
- Only L segment with old items (LO segment) participates in exchange at price $(P_i - e_i)$.
- HO, HN and LN (N: segment without old) pay $P_i$
Sequence of Events

Stage 1
- Firms decide whether or not to offer exchange program.

Stage 2
- If offering exchange, announce retail price $P_i$ and exchange discount $e_i$.
  - If not offering exchange, set retail price $P_i$.

Stage 3
- H & some LN consumers buy new.
- Some LO consumers turn in old, buy new.
- Consumers shop and buy.
Analysis of Three Subgames

1. Case NN: Neither firm offers exchange program

2. Case YY: Both firms offer exchange programs

3. Case YN (NY): Firm A(B) offers exchange, while Firm B(A) does not
No Exchange (NN) Equilibrium

- When $\lambda$ is sufficiently large, Case NN is always the equilibrium, regardless of fraction of old good owners, $f$
- All consumers pay the same price
- $P^{NN} = \frac{2\lambda\theta_L + t(1-\lambda)}{1+3\lambda}$, $\Pi^{NN} = \frac{(1+\lambda)(2\lambda\theta_L + t(1-\lambda))^2}{2t(1+3\lambda)^2}$
- LO may be worse off than LN consumers: $M_L - K < 0$
- Similarly, HO may be worse off than HN consumers: $M_H - K < 0$
Exchange (YY) Equilibrium

- When $\lambda$ is sufficiently small, Case YY is always the equilibrium, regardless of fraction of old good owners $f$
- HO, HN and LN consumers pay full retail price, LO gets exchange discount
- Retail price $P_{YY} = \frac{t(1-\lambda)+2(1-f)\theta_L\lambda}{1+(3-4f)\lambda}$
- Effective price for LO:
  $EP_{YY} = P_{YY} - e_{YY} = \frac{1}{2}(-a + K - 2M_L + \theta_L)$. 
Exchange Equilibrium Implications

- \( \frac{\partial P^{YY}}{\partial \lambda} < 0 \)
- \( \frac{\partial P^{YY}}{\partial f} > 0 \) Negative externality of LO on HO, HN, and LN segments.
- \( P^{YY}(f = 1) = t \), the highest duopoly price
- \( EP^{YY} \) is independent of \( \lambda \) and \( f \). \( \frac{\partial e^{YY}}{\partial \lambda} < 0, \frac{\partial e^{YY}}{\partial f} > 0 \)
Impact of $f$ and $K$ on Exchange Equilibrium

- Likelihood of exchange equilibrium increases as fraction of old good holders $f$ increases
- “Opposing Effect” of $f$ and $\lambda$ on the range of exchange equilibrium
- Likelihood of exchange equilibrium increases as storage cost $K$ increases
- When $K$ is very large, even HO segment may participate in exchange (work in progress)
Proposition

When $\lambda \leq \lambda^*$, though Case YY is more profitable than Case NN, Case NN may still be equilibrium outcome

$\lambda^*(f = 1) = \frac{-3(a-K+2M_L)^2+6(a-K+2M_L)\theta_L+\theta_L^2-4\left(t^2+\sqrt{\frac{t^2}{9}}+\frac{(a-K+2M_L)(a-K+2M_L-2\theta_L)}{9(a-K+2M_L)^2-20t^2+2(-9a+9K-18M_L+4t)\theta_L+\theta_L^2}}\right)}{9(a-K+2M_L)^2-20t^2+2(-9a+9K-18M_L+4t)\theta_L+\theta_L^2}$

- $\lambda^*$ decreases in $\theta_L$ and $M_L$, increases in $f$
- Such a Prisoner’s Dilemma equilibrium is more likely for large values of $\lambda \leq \lambda^*$

Graphical Analysis Equilibrium Outcomes
Analysis of the Prisoner’s Dilemma Equilibrium

- Recall Case NN $\rightarrow$ no price discrimination
  Case YY $\rightarrow$ price discrimination

- From Case YY to Case YN, by dropping the exchange program, Firm B gains in LO (no longer needs to account for $M_L + a$) but incurs losses in LN, HO, and HN

- From Case YN to Case NN, by dropping the exchange program, Firm A also gains in LO and loses in LN, HO, and HN. But loss in LN, HO, and HN decreases quickly in $\lambda$

- Hence Prisoner’s Dilemma occurs at large values of $\lambda$ when $\lambda \leq \lambda^*$
Coordination Equilibria

Proposition

When \( \lambda \) is moderately below \( \lambda^* \), coordination equilibria arise. Both Case YY or Case NN can be the equilibrium outcome. Case YY is Pareto Superior.

In this range, firms have diverging incentives when starting from Case YN/NY:

- \( \Pi^{NN} > \Pi^{YN} \). Conditioning on Firm B not offering exchange, Firm A should not offer an exchange.

- \( \Pi^{YY} > \Pi^{NY} \). Conditioning on Firm A offering exchange, Firm B should offer an exchange.
Illustration of Firm Profits and Equilibrium Strategies

Firm Profits and Equilibrium Strategies

- \( \Pi^{NN} \)
- \( \Pi^{NY} \)
- \( \Pi^{YY} \)
- \( \Pi^{YN} \)

- Exchange Equilibrium
- Coordination Equilibria
- NN Equilibrium Prisoners' Dilemma
- No Exchange Equilibrium

Profit

\( \lambda^* \)
Impact of Loss Aversion

\[ \frac{\partial \Pi^Y}{\partial a} = \frac{\lambda f(a - K + 2M_L - \theta_L)}{2t} < 0 \]
\[ \frac{\partial e^Y}{\partial a} = \frac{1}{2}, \quad \frac{\partial x^Y_{LO}}{\partial a} = -\frac{1}{2t} \]

An increase in \( a \) decreases the range of exchange equilibrium

An increase in \( a \) increases the range of NN Equilibrium as a Prisoner’s Dilemma

An increase in \( a \) decreases the range of firms “subsidizing” exchange.

\[ (P^YY - P^{NN}) - (P^{NN} - EP^YY) < 0 \]
Summary and Work-in-Progress

- Exchange programs as a discrimination
- “No exchange” as a Prisoner’s Dilemma outcome
- Impact of loss aversion
- Extension: Impact of waste aversion
- Buyback programs a la Best Buy
- Importance of Exchange Program to consumers, firms and society
Future Research

- Incorporate cost/benefit of exchanged old goods
  - $M$ becomes the economic value of the used items
  - Reverse logistics
- Green concerns: $Z = M + a < 0$ — consumers are happy to get rid of their old goods
- H segments will participate in exchange programs
1. Neither Firm Offers Exchange Programs (Case NN)

\[ \bar{x}_{HO} = \bar{x}_{HN} = \frac{P_B - P_A + t}{2t} \]
\[ \bar{x}_{LO} = \bar{x}_{LN} = \frac{\theta_L - P_A}{t} \]

\text{Firm A:} \quad \text{Max} \quad \Pi_A = P_A ((1 - \lambda) \bar{x}_H + \lambda \bar{x}_L) \\
\text{Firm B:} \quad \text{Max} \quad \Pi_B = P_B ((1 - \lambda)(1 - \bar{x}_H) + \lambda \bar{x}_{BL}) \\
\frac{P_A^{NN} = P_B^{NN}}{2 \lambda \theta_L + t(1 - \lambda)} = \frac{1 + 3 \lambda}{1 + 3 \lambda}, \\
\frac{x_{LO}^{NN} = x_{LN}^{NN}}{(1 + \lambda) \theta_L - t(1 - \lambda)} = \frac{t(1 + 3 \lambda)}{t(1 + 3 \lambda)} \\
\Pi^{NN} = \frac{(1 + \lambda)(2 \lambda \theta_L + t(1 - \lambda))^2}{2t(1 + 3 \lambda)^2}
2. Both Firms Offer Exchange Programs (Case YY)

- **Firm A demand is:**
  \[
  \bar{x}_{AHN} = \bar{x}_{AHO} = \frac{P_B - P_A + t}{2t}, \\
  \bar{x}_{ALN} = \frac{\theta_L - P_A}{t}, \\
  \bar{x}_{ALO} = \frac{\theta_L - P_A + e_A - 2M_L - a}{t}
  \]

- **Firms’ optimization problems:**
  \[
  \Pi_A = \text{Max } P_A (1 - \lambda) \bar{x}_{AH} + (P_A - e_A) \lambda f \bar{x}_{ALO} + P_A \lambda(1 - f) \bar{x}_{ALN} \\
  \Pi_B = \text{Max } P_B (1 - \lambda)(1 - \bar{x}_{AH}) + (P_A - e_A) \lambda f \bar{x}_{BLO} + P_B \lambda(1 - f) \bar{x}_{BLN}
  \]

- **P_{YY}**
  \[
  P_{YY} = \frac{t(1-\lambda)+2(1-f)\theta_L \lambda}{1+(3-4f)\lambda},
  \]

- **e_{YY}**
  \[
  e_{YY} = \frac{-a + K - 2(M_L + t) + \theta_L + (a(-3+4f) + (3-4f)K - 6M_L + 8fM_L + 2t - \theta_L) \lambda}{-2 + (-6+8f)\lambda}.
  \]
2. Discussion of Case YY

- With the exchange program,
  - Firms charge a higher gross price before discount
  - HN, HO, and LN pays more ($P^{YY} > P^{NN}$)
  - LO pays less ($P^{YY} - e^{YY} < P^{NN}$)

- When $\lambda \geq \frac{(2t - \theta_L) - (2M_L + a) + K}{(2t - \theta_L) + 3(2M_L + a) - 3K}$, market coverage in L drops: $x_{LO}^{YY} \leq x_{LO}^{NN}$

- $X_{LN}^{YY} < X_{LO}^{YY} < X_{LO}^{NN} = X_{LN}^{NN}$

- So the exchange program can decrease coverage in both LO and LN segments.
“Cost” of Exchange in Case YY

- HO, HN, and LN’s additional price in Case YY compared to Case NN: \( P_{YY} - P_{NN} \).
- LO’s exchange discount in Case YY: \( P_{NN} - EP_{YY} \).
- \( (P_{YY} - P_{NN}) - (P_{NN} - EP_{YY}) < 0 \),
  - when \( f \) is below a threshold. This means that both firms and HO, HN and LN consumers bear the cost of exchange programs for LO consumers
  - otherwise only HO, HN and LN consumers “subsidize” exchange for LO consumers
3. Asymmetric Exchange Policies (Case YN/NY)

- Assume only Firm A offers exchange, firms’ demands are:
  \[ \bar{x}_{YN} = \bar{x}_{YN} = \frac{P_B - P_A + t}{2t}, \quad \bar{x}_{YN} = \bar{x}_{YN} = 1 - \bar{x}_{HN}; \]
  \[ \bar{x}_{YN} = \theta_L - P_A + e_A - 2M_L - a + K, \quad \bar{x}_{YN} = \theta_L - P_A; \]
  \[ \bar{x}_{LN} = \bar{x}_{LN} = \frac{\theta_L - P_B}{t}. \]

- Equilibrium prices are:
  \[ P_{YN} = \frac{t(-1+\lambda)(3+\lambda)+2\theta_L\lambda(-3-\lambda+2f(1+\lambda))}{-3+\lambda(-10-3\lambda+8f(1+\lambda))}; \]
  \[ e_{YN} = \frac{1}{2}(a - K + 2M_L - \theta_L) + \frac{t(-1+\lambda)(3+\lambda)+2\theta_L\lambda(-3-\lambda+2f(1+\lambda))}{-3+\lambda(-10-3\lambda+8f(1+\lambda))}; \]

- YN or NY never emerges as the equilibrium outcome.